Systems for Maintenance of Urinary Sterility After Prostatectomy

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■ *Closed drainage is recommended for all patients after prostatectomy where hemostasis has been adequate. Although closed drainage can maintain sterility of the bladder, thereby fostering healing and reducing infectious complications, such drainage is not insisted upon at most hospitals because of the inconveniences associated with it. However, when closed drainage was used in 25 consecutive cases of transurethral resection, infection was reduced to 25 per cent (in contrast to the 85 to 100 per cent encountered with open drainage).*

The ideal closed system should incorporate:

1. Fixed tubing to prevent contamination where the catheter joins the tubing and where the tubing is attached to the container;

2. An aseptic method of emptying;

3. A device to prevent reflux of the potentially contaminated urine in the container into the bladder;

4. Free urinary flow from bladder to container; and

5. Portability for the patient and convenience for the staff.

A system is proposed that incorporates these features. Particularly effective are a fixed drip chamber with vents at the site of attachment of the tubing to the bag and a protected spigot for emptying.

THE BACTERIA THAT infect the urine after prostatectomy are most often those that have been transferred from other patients.[8,9,17,18] Less often, they come from the patient himself.[12,14] In the former instance, the ascent of bacteria from a contaminated drainage bottle appears to be the most frequent cause of infection during indwelling catheterization.[22] It is known that the vesical defense mechanism cannot rid the bladder of infection if bacteria are introduced repeatedly or in overwhelming amount.[3,4] These defenses are further reduced by presence of a foreign body (in this case, the catheter), by the instrumentation neces-

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sary for transurethral resection, and by the effects of the prostatic wound. It seems probable, therefore, that maintenance of urinary sterility after operation would reduce complications, although statistical support of this statement is not yet available.*

Catheter drainage of two to five days appears necessary for the management of patients after prostatectomy. The inconveniences and hazards of omitting it are usually greater than its harmful effects. Attention, then, must center on the most reliable and practical method of maintaining sterility of the urine for the required period of catheterization.

Since Pyrah and his group[21] reported the effectiveness of "closed drainage" after prostatectomy, numerous investigators have reported reduced incidence of post-prostatectomy infection with its use.[10] Chart 1 illustrates the typical effects. The greatest reported change was from 83 per cent infected when sterile precautions were not used to 6 per cent when such precautions were applied. If this is so, why has strict closed drainage not been universally adopted?

The answer is: It is a nuisance to maintain a sterile system. The physician and nurse wish to irrigate the catheter to keep it free from clots. The patient prefers to walk around unimpeded. The orderlies like to collect the urine without the bother of special maneuvers or techniques. Consequently, to obtain universally the benefits of keeping the urine free of infection after operation, systems must be devised that are not only effective but are acceptable to all persons concerned. In the study here reported, we examined the properties of a closed drainage system in order to suggest a more acceptable system than those available.

Requirements for "Closed Drainage"

Five factors must be present in any drainage system if it is to be used as an effective barrier to the introduction of infection:

1. PERMANENTLY AFFIXED TUBING, to prevent contamination of its junctions with the catheter and container;

2. AN ASEPTIC METHOD OF EMPTYING THE CONTAINER (or, alternatively, antiseptics placed in the container);

*Since this manuscript was written Plorde and coworkers[20] have shown that surgical complications after prostatectomy were more frequent in patients with postoperative bacteruria.

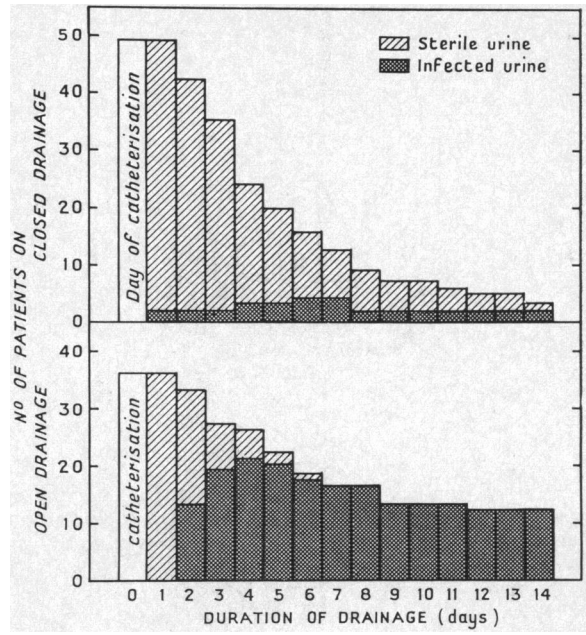

Chart 1.—Effect of open and closed drainage on the incidence of infection after prostatectomy (from Miller, A. and coworkers[14]).

3. AN ANTI-REFLUX DEVICE to prevent back flow of fluid from container to bladder;

4. FREE FLOW; and

5. PORTABILITY AND CONVENIENCE OF USE.

1. *Permanently affixed tubing.* To assure sterility, the drainage tubing must be attached aseptically to the catheter at the conclusion of the operation and taped in place to make unauthorized disconnection difficult. This should be done in the operating room, not in the recovery room. The distal end of the tubing, if permanently attached to the container, is not easily contaminated.

2. *An aseptic method of emptying the container.* A container that must be emptied by removal of a cap through which the drainage tube extends, as it does in most instances, is subject to contamination. Thus, another route for periodic emptying must be employed.

A vent that opens when the bag is tipped and closes when it is upright is the simplest mechanism but, since it is essentially open, it too carries the risk of contamination. A spigot at the bottom of the container can be closed with a valve or clamp. However, contamination of the spigot's spout can possibly result in retrograde ascension of bacteria.

3. *Devices to prevent backflow of contaminated urine from container to bladder.* Three devices

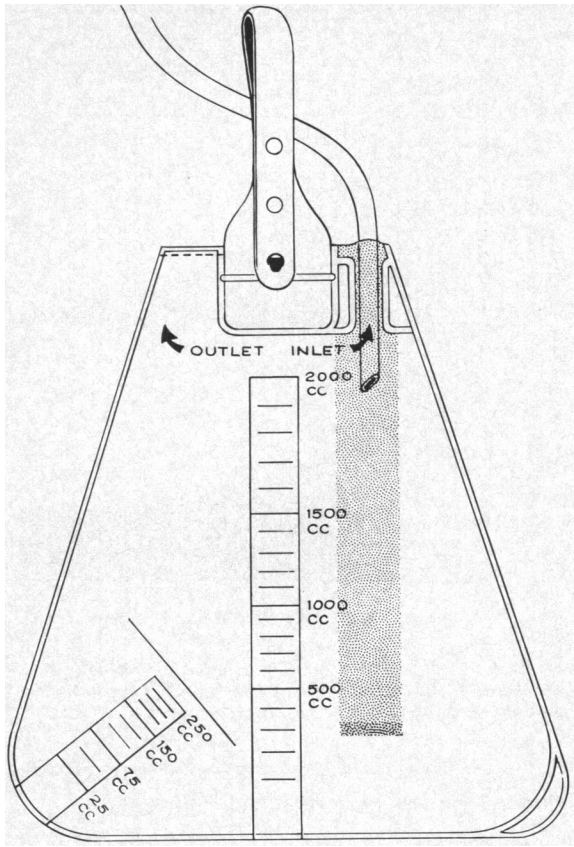

Figure 1.—Flutter valve. The Meredith drainage set, Eschmann Bros. and Walsh, Ltd., Shoreham-by-sea, Sussex, England.

are in use: (a) vents to release the urine before enough pressure is built up to produce backflow; (b) valves; and (c) chemicals in the container that render the urine sterile.

A vent, to be effective, must be at the point of inflow (for example, incorporated with the cap). Otherwise, when the container is put down (as on the edge of the wash basin while the patient is defecating), its contents may be siphoned back into the bladder.

The drip chamber has been demonstrated to be effective as a valve. A flutter valve (Figure 1) might be expected to allow ascent of bacteria along its interior interface, although experiments have not shown that this is necessarily so.[16]

Chemicals in the container may be harmful to the bladder if siphonage does occur. They are probably practical only in gallon glass jugs that are too large to be raised above bladder level and that have large vents which permit the urine to escape before it can return to the bladder. The instillation of a non-toxic antibacterial agent into the container each time it is emptied would, however, decrease the chances of vesical contamination.

4. *Free flow.* The hydraulics of catheter drainage are generally poorly understood. Drainage tubing of small diameter (3/16 inch) will usually remain filled with urine and, hence, exert a siphon effect; in large tubing (9/32 inch), the siphon is usually broken and urine levels off in the loop in balance between inflow and outflow. That back-pressure is not exerted in the smaller tubing is obvious. In the larger tubing, the fact that the meniscus in the proximal side of the loop is at the same height as that in the distal side shows manometrically that no back-pressure exists. The exceptions to this, of course, are instances in which the tubing is looped above the level of the bladder. If the tubing is looped below the level of the container, flow will continue on into the container as soon as the two sides fill to the level of the entrance to the container.

An objection to the smaller tubing is that clots may not pass through it. However, since a 24 F Foley (and red rubber) catheter has a bore of 14 F, approximately the same bore as the tubing, no obstruction should be expected unless the adapter has a smaller bore than the tubing.

For the maintenance of free flow, the container must either have vents to allow the displaced air to escape, or have easily expansible sides.

5. *Portability, and convenience to the patient and the staff.* Since ambulation is important postoperatively, the apparatus should be easily port-

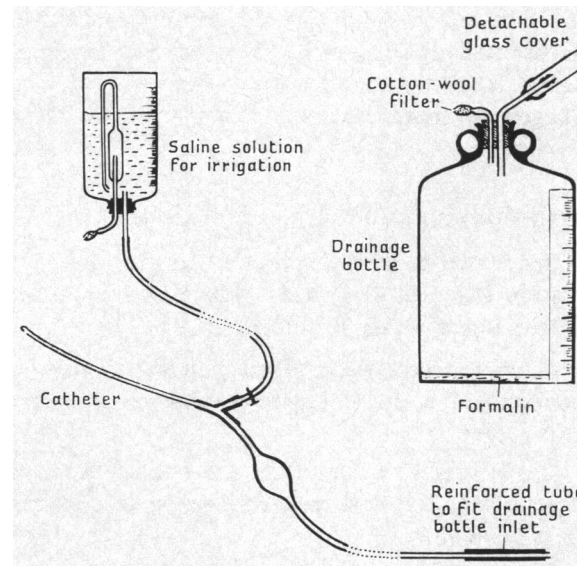

Figure 2.—Closed drainage with provision for irrigation (from Miller, A. and coworkers.[14]).

able. Construction from plastic materials has made this possible. A further convenience is a container sufficiently rigid to stand by itself. This is not essential, however, and a reasonable alternative is a flat bag that can be pinned to the patient's gown.

Convenience to the staff is a consideration not to be taken lightly. If the apparatus requires a complicated aseptic technique to maintain sterility during emptying, a break in sterility can be expected. Containers that empty by tipping or through a spigot will have a better chance of remaining sterile than those requiring disconnection of any parts.

Additional Means

Other types of closed systems not included in the preceding considerations are those arranged for intermittent or continuous irrigation. Miller and coworkers[15] described the prototype of these systems (Figure 2) incorporating a sterile reservoir, a Y-connector, an integral bulb pump and a floor container. Our limited experience with apparatus of this type, which is needed only in those cases in which significant postoperative bleeding with clots is anticipated, has not been good. Overfilling of the bladder, with consequent leakage at the site of prostatic capsular closure, has occurred. In these patients, open irrigation with aseptic precautions is more effective and, although less secure bacteriologically, assures a more satisfactory postoperative course since control of bleeding and leakage take precedence over maintenance of asepsis.

No discussion will be undertaken here of antiseptic irrigations [11,13] or of special measures applied to the urethra.[2,6,7] Prophylactic antibiotics probably play no role unless a break in sterile technique occurs.[1,5,19]

Experience with Closed Drainage

Twenty-five consecutive patients in whom closed drainage was maintained for two to three days after transurethral resection of the prostate for benign prostatic hypertrophy were studied by preoperative urinalysis and methylene blue smear and postoperative urine culture with colony count four days to two weeks after removal of the retention catheter. Typed instructions (see box below) were provided for the nursing staff. The results of this study are shown in Chart 2. Of those patients with sterile urine before operation, 75 per cent continued to have sterile urine. The 25 per cent of cases in which the urine became infected included those in which postoperative bladder irrigation was necessary or the closed system was opened unnecessarily.

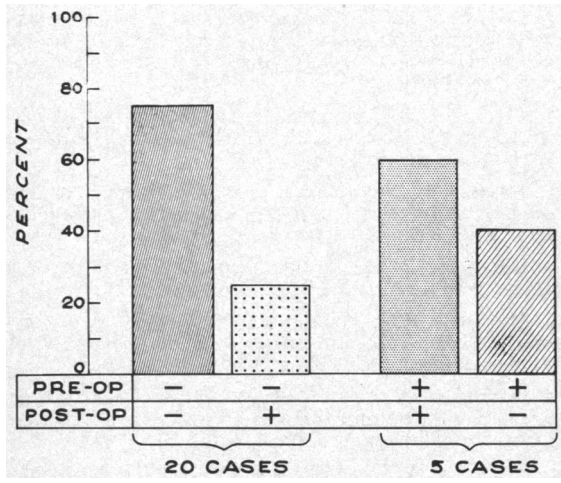

Chart 2.—Incidence of infected urine before and after transurethral resection with closed drainage in a personal series of 25 consecutive cases—20 in which the urine was sterile (−) before operation and 5 in which it was infected (+).

INSTRUCTIONS TO NURSING STAFF

(To be placed in patient's chart following appropriate written orders.)

Date:_____ Patient:_____

Location:_____

THIS PATIENT'S CATHETER IS TO BE MAINTAINED ASEPTICALLY . . . to prevent cross infection by hospital organisms. This drainage system has been connected sterily in the operating room. Any break in technic will contaminate the patient's bladder.

ORDERS:

(1) Keep *catheter connected to drainage tube.* If irrigation is absolutely necessary because of obstruction, call house officer to perform it aseptically (gloves, sterile towels, scrubbed catheter end, fresh irrigation set up). Never use leg bags or catheter plugs.

(2) Keep *distal end of drainage tube* sterile. Handle aseptically, in sterile collecting bottle or bag. Do not allow end to touch urine in bottle or bag.

(3) Cleanse male meatus daily with Phisohex. Keep catheter taped to leg.

Signed_____, M.D.

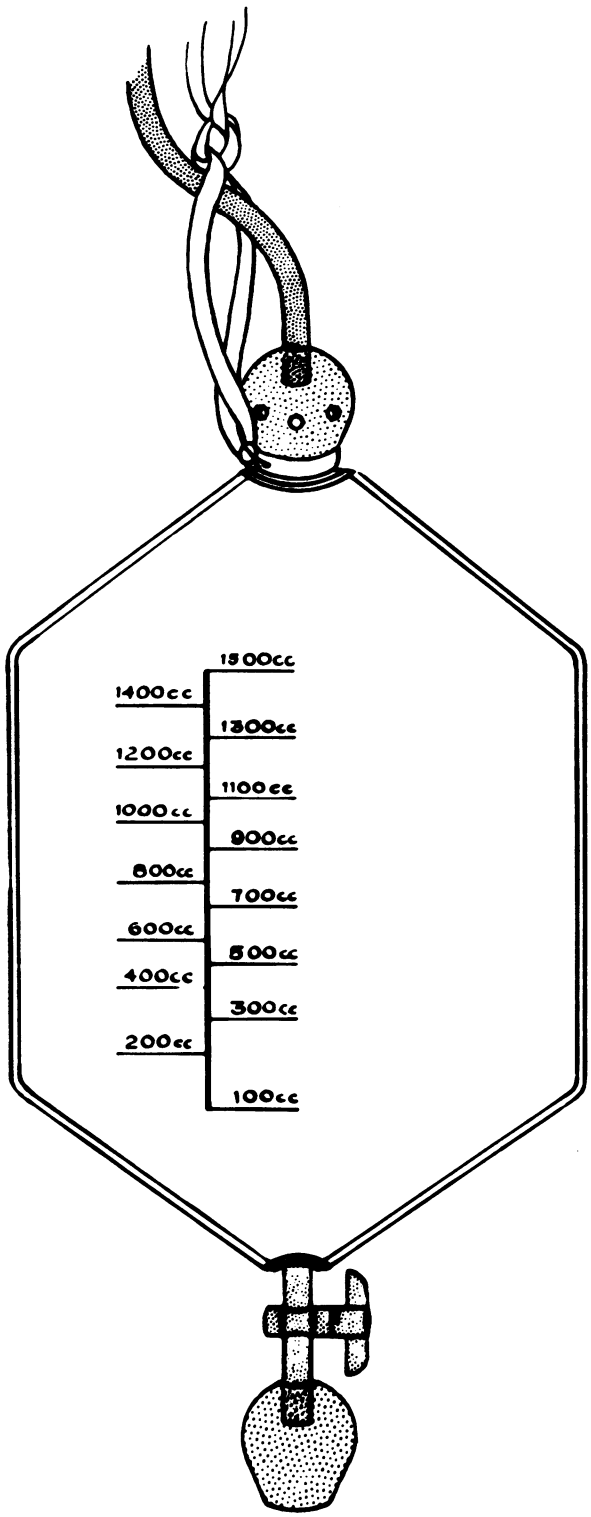

Figure 3.—Proposed aseptic bag system. Note: 1. fixed inlet tubing; 2. drip chamber at inlet; 3. overflow vents; 4. spigot, with drip chamber.

Plan for an Improved Apparatus

A system incorporating the desirable features of the several devices now available with protection from contamination of the emptying mechanism is proposed (Figure 3). It provides the five factors believed essential to asepsis. (It must be pointed out, however, that experimental or clinical proof of the effectiveness of these arrangements has not yet been obtained.) Features of the system are:

1. Fixed tubing. The "cap" cannot be disconnected.

2. An aseptic method of emptying. The spigot lies inside a drip chamber so that contamination, except by air-borne bacteria, is difficult.

3. An anti-reflux device incorporated in the "cap." Vents are provided which let the urine leak out before it can either touch the drainage tube or flow up the lumen of the tube.

4. Free flow, provided by the vents and by the flexible structure of the plastic bag.

5. Portability, assured by the flat shape of the bag and the cotton tapes to tie it to the bed or pin it to the patient's gown. Convenience to the staff is provided by the dependent spigot.

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